

Living Safely on Planet Earth

Remarks by Lynn Orr, Dean of the School of Earth Sciences to the participants at the Crowding the Rim Conference, August 1-3, 2001

I am delighted to add my welcome to that of President Hennessy and the School of Earth Sciences to the participants in this shared endeavor, Crowding the Rim. It is completely fitting that we hold this meeting here at Stanford. We here have direct experience of the kinds of events we spent the day talking about. In 1906, a magnitude 8 earthquake shut down the university for a year. So we do understand firsthand the importance of being prepared for natural hazards. As I see it, we are confronting these few days one of the grand challenges of this twenty-first century: How do we humans learn to live on this planet and do it in a way that can be sustained in the long term. Many of the themes I'll mention have already been touched on by our speakers-but let me remind you of what lies ahead. The challenges are huge ones. We have a growing population, six billion now and counting, and we must find ways to feed them, provide clean water, keep them warm and cool, and employ them productively. So how do we do that?

It seems to me that there are at least four elements of learning how to do this. I'll mention them and then say a few words about each. We need to:

- understand our home planet much better than we do-that's the science
- mitigate with perseverance-this will challenge us technically and in our institutions
- work together-we can't say this enough and we need to do it much better
- educate

First on my list is understanding the science of this restless Earth on which we live. I suppose it's first on my list because my colleagues and I here at Stanford in the School of Earth Sciences, and also nearby at the U.S. Geological Survey, spend our scientific lives thinking about these problems. We heard today about the risks of earthquakes, volcanoes, typhoons, and tsunamis. We need to understand much better how earthquakes and volcanoes work, how often they will happen and what the effects will be. These cataclysmic events remind us of the power of the natural systems that shape our lives. But with instruments, communications, and good science, we can do a much better job of preparing ourselves for these events. What can science do for us. Mary Lou Zoback mentioned this morning the idea of using repeated radar images to measure how volcanoes bulge prior to eruption. Radar interferometry can measure small movements of the surface of the volcanoes. Imagine how much better prepared we could be if we watched all the volcanoes on Earth from space with a satellite. There are somewhere around 500 volcanoes active on Earth, and about 30 erupt each year. How much better it would be if we could monitor from afar all those volcanoes and provide timely warnings to those nearby. With better and more broadly deployed seismic instrumentation, we can understand much better the dynamics of the great blocks of rocks that we call continents. I like to imagine a global, but targeted, seismic network that would allow us to pinpoint areas of strong shaking. Predictions and warnings will still be

difficult, but we can surely improve our understanding of the risk and what we can do to mitigate it. Now these are not easy problems to work on because we don't have the luxury of lining up five planets and trying a different planetary experiment on each one. We just have this one to work with. One way to do this is to look back in time, to reconstruct the history of the Earth, both the tectonic history and other aspects, climate, for example, to understand what happened and why and to look forward to what we can expect. Dave Howell made this point eloquently. The grand biochemical and geochemical cycles that move carbon and other elements around the planet provide the basis for all life, ours included. As we humans modify these planetary cycles, with agriculture, clearing of forests, energy use, and consumption of fresh water, we need to understand much better what those impacts might be. We depend on these systems to support us and process our wastes, and we need to understand them as systems. Those of us who live in California are reminded regularly by El Nino events that what happens across the Pacific matters to us here - it has a huge impact on rainfall amounts in Northern California. Well, I could go on and on, but I'm hungry, too, so I'll end this review of the need for work in the Earth sciences by noting that Earth scientists necessarily take the long view-because we think about systems with time scales that are decades to hundreds to thousands of years.

Those time scales are long for humans, but they are relevant to those of us who are gathered here today. And they influence my next point: mitigation. The natural hazards we are considering occur at long intervals. Those can lull us into a false sense of security - you know the reasoning, I've been here for fifty years and that volcano hasn't erupted; why should I worry about it? While the long time interval is a problem in convincing people and governments about risk, it also gives us an opportunity, and an obligation, to work on mitigation over time and for the long haul. There is much we can do and on many fronts: better building codes and structure designs, (Brent Woodworth mentioned an example of doing this within cost constraints that are reasonable for the location in question) better management of infrastructure and emergency planning, educating our public.

It is important to start now, to work steadily, and to keep at it. It may seem slow, but as we integrate over time, the impact will be large. We must do this. Earthquakes don't kill people, buildings do. And we can fix buildings. Stanford is actually a small scale example of this. In the mid 1980s we stopped buying earthquake insurance, and instead used the money to strengthen buildings. The result was much less damage to buildings and humans, than would have been the case in the 1989 earthquake here.

That brings me to my next point. No one country or organization can do this alone. We must work together. Our infrastructures are linked. Our economies are more and more tied one to another. The global systems that supply energy and food are tightly coupled. Therefore we have a large and growing common interest in being prepared. James Lee Witt, Ron Oguchi, Brent Woodworth, Zen Delica, and James Losi all made this point in various ways. The lives, and jobs, we save will be our own. These are not just theoretical concepts. When the recent earthquake occurred in Taiwan, the impact

was felt here in Silicon Valley in just a few days as electronic parts needed for assembly of computers failed to arrive, just in time. The fact that we are gathered together is evidence that we can do this. We can learn what works from each other, and we can help give visibility to our shared endeavor.

And that brings me to my final point: education. We have a big task here, on several levels. We need to create a cadre of young people who know much more about how the Earth and its biogeochemical systems work as well as how human economic and policy systems interact with them. I can't resist inserting a plug for our Earth Systems interdisciplinary undergraduate program. It attempts to educate just that sort of person. We need them to flow into government at all levels. We need to educate our governments at all levels to understand the hazards for which we must prepare. We need to share expertise and experience, and we have much to do to persuade our population to take seriously the task of preparing for events that may be a long time coming. The participation of many educators and students in this conference is a step toward this goal.

So I will close, with a word of thanks to Don Kennedy and Dave Howell and their happy troop of dedicated colleagues, students and staff. You have brought us together to do the work that needs to be done. So let's get to work and do it. I'll ask you to find a glass that has something in it and raise it with me: to good science applied to saving lives and living sustainably on our home planet, to building the links between people and organizations that make it possible to protect lives and serve our growing population, to finding ways to reduce risk in ways that we can afford, and to an educational process that makes us all aware of what we need to do.